



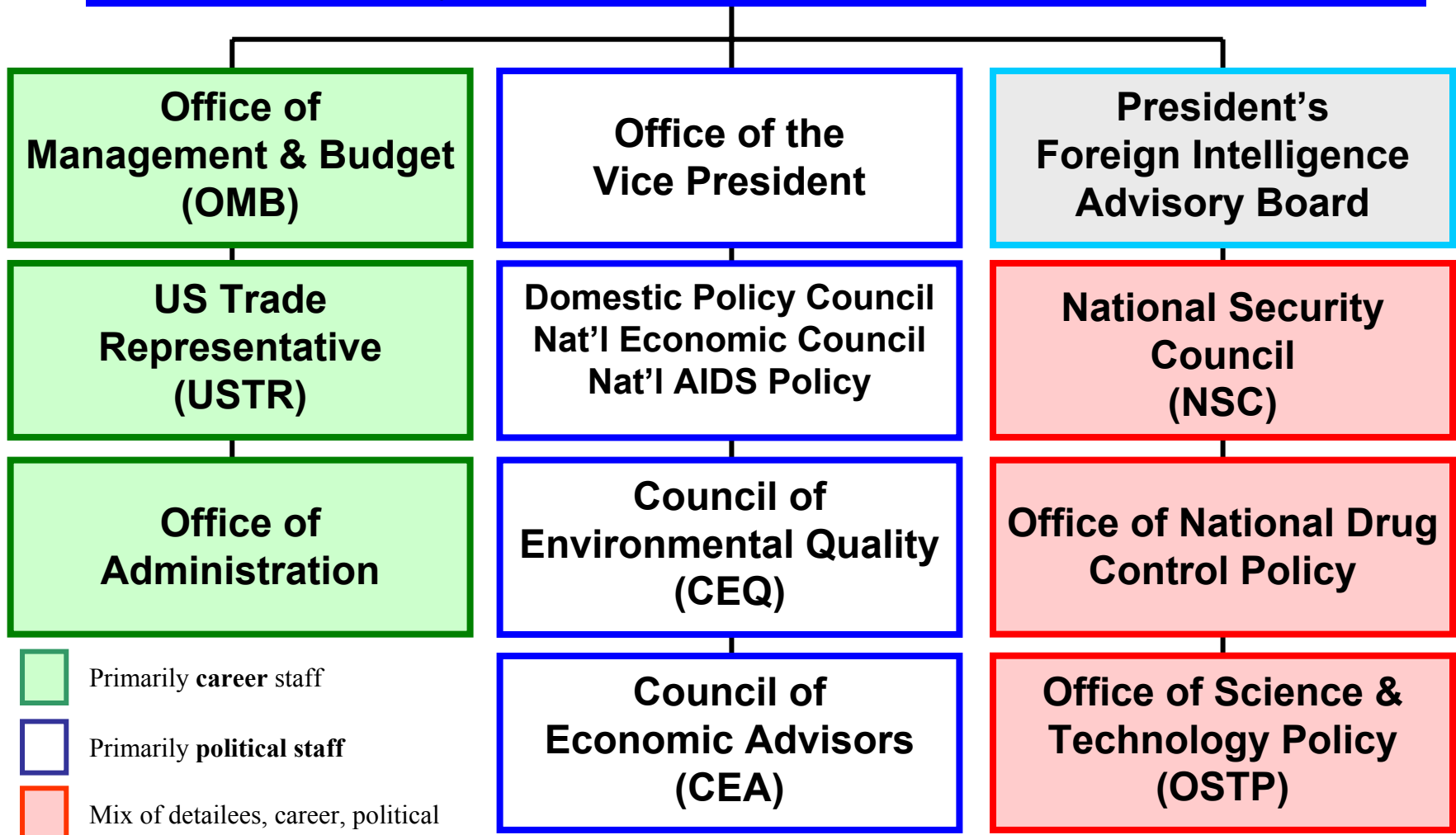
X-Ray and Neutron Scattering Facilities: A National Policy Perspective

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Executive Office of the President

Executive Office of the President (EXOP)

White House Office

(Homeland Security Council, Office of Faith-Based Initiatives, Freedom Corps)



OSTP Mission:

- 1. Advise the President** (and by implication, EOP.)
- 2. Lead interagency effort** to develop sound S&T policies & budgets.
- 3. Work with the private sector** to match S&T investments to needs.
- 4. Build strong partnerships** among Federal, State, and local governments, other countries, and the scientific community.
- 5. Evaluate** the scale, quality, and effectiveness of the Federal effort in science and technology.

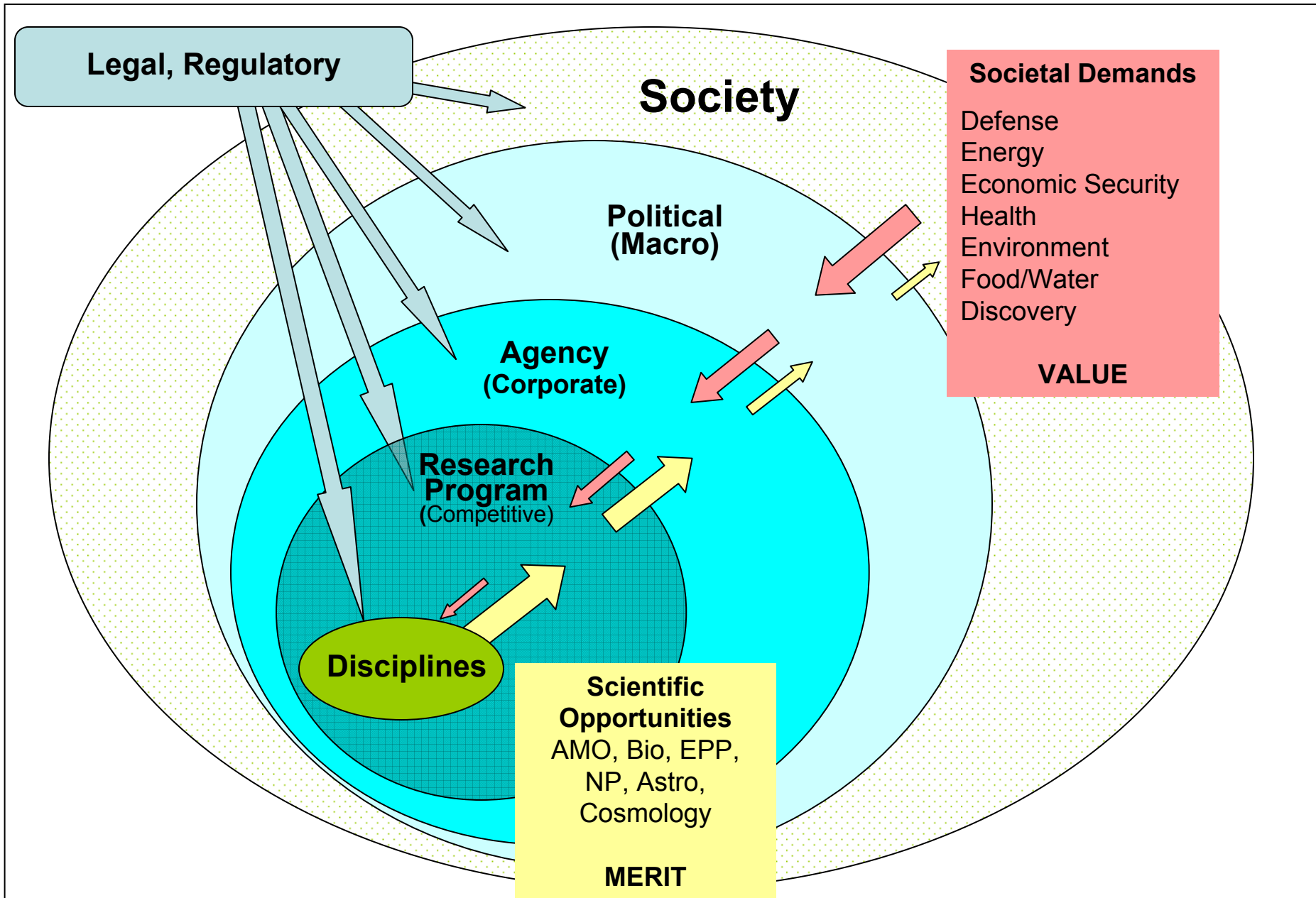
External Policy Advisors:

President's Council of Advisors on Science and Technology (PCAST)
President's Information Technology Advisory Committee (PITAC)

Intergovernmental Policy Council:

National Science and Technology Council (NSTC)

“Business Environment” for Government R&D



Factors Influencing the Directions of Science

Scientific Push

(opportunities)

- Bio (e.g. genomics)
- Nanoscience & technology
- Intersection of Particle Physics and Astronomy

Societal Pull

(demands)

- {Homeland & National} Defense
- Energy
- Economic Security
- Health
- Environment
- Food/Water
- Exploration

R&D Environment

(capacity & infrastructure)

- Capital (\$)
- Technology (Tools)
- People (Talent)
- Legal (Policy, Leg. Regulation)
- Ethical

Presidential Priorities

w/ Direct S&T Coupling



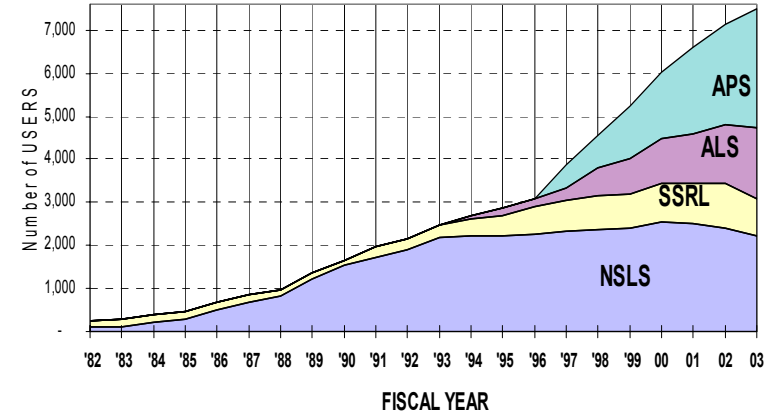
- Winning the War on Terrorism
- Securing the Homeland
- Strengthening the Economy
- A National Energy Strategy
- Improving Government: President's Management Agenda
(R&D Investment Criteria, PART Analysis)

FY 2006 OSTP/OMB Priorities Memo

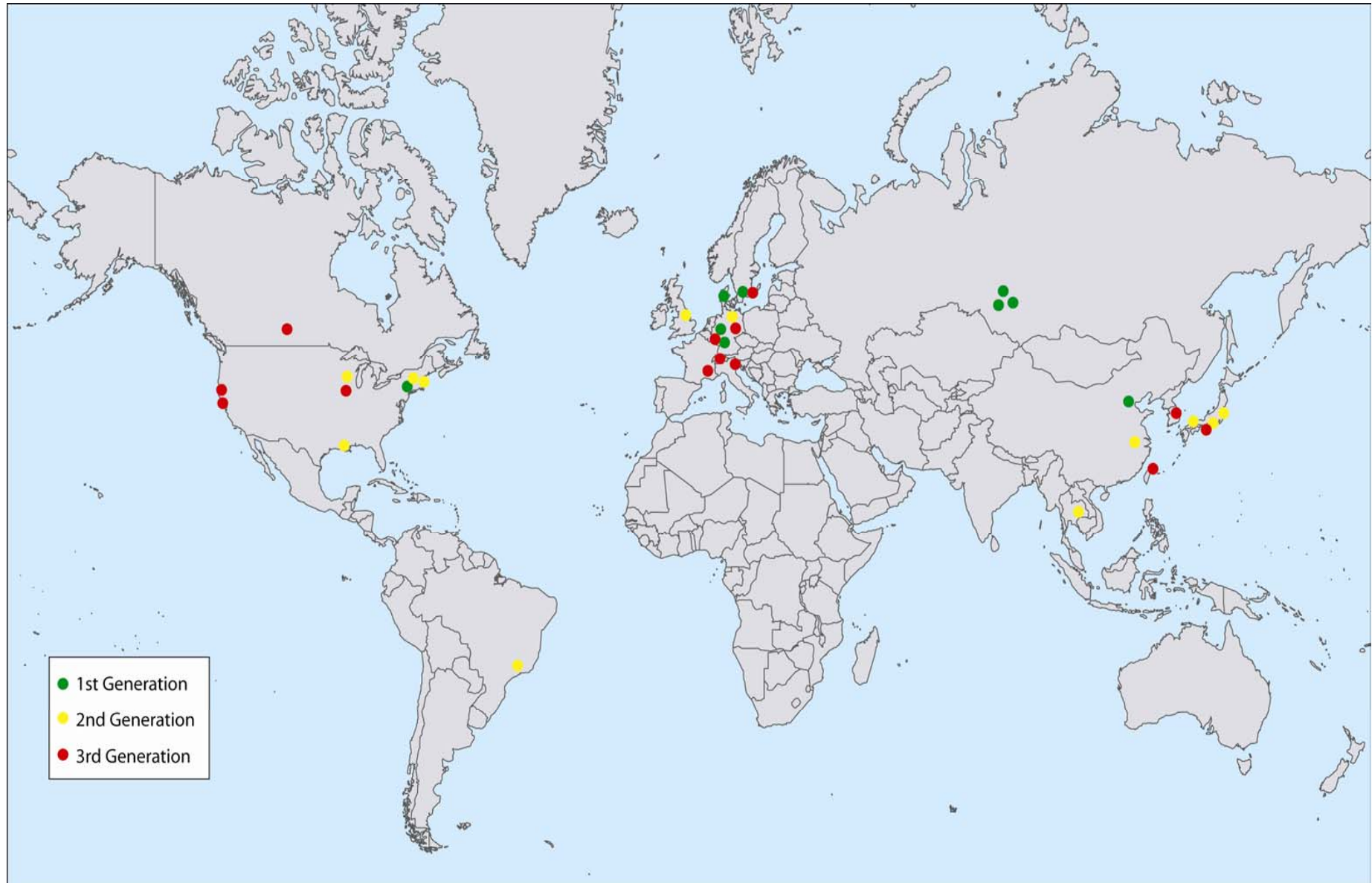
- 1.) R&D for Homeland and National Security**
- 2.) Networking and Information Technology R&D (NITRD)** (includes scientific computing)
- 3.) Nanotechnology (NNI)**
- 4.) Priorities for the Physical Sciences**
- 5.) Biology of Complex Systems**
- 5.) Environment and Energy**
 - climate change
 - environmental observations
 - hydrogen R&D

X-Ray and Neutron Scattering Facilities

- large investment base (\$7B - \$10B)
- currently serve ~10,000 researchers
 - majority from universities
 - #'s growing (limited by capacity)
 - over-subscribed
- have the greatest impact of any facilities
 - # of disciplines
 - materials, chem, bio, physics
 - Scientists/users
 - Relevance to national needs
 - energy, environment, economic growth, health, national security, etc.



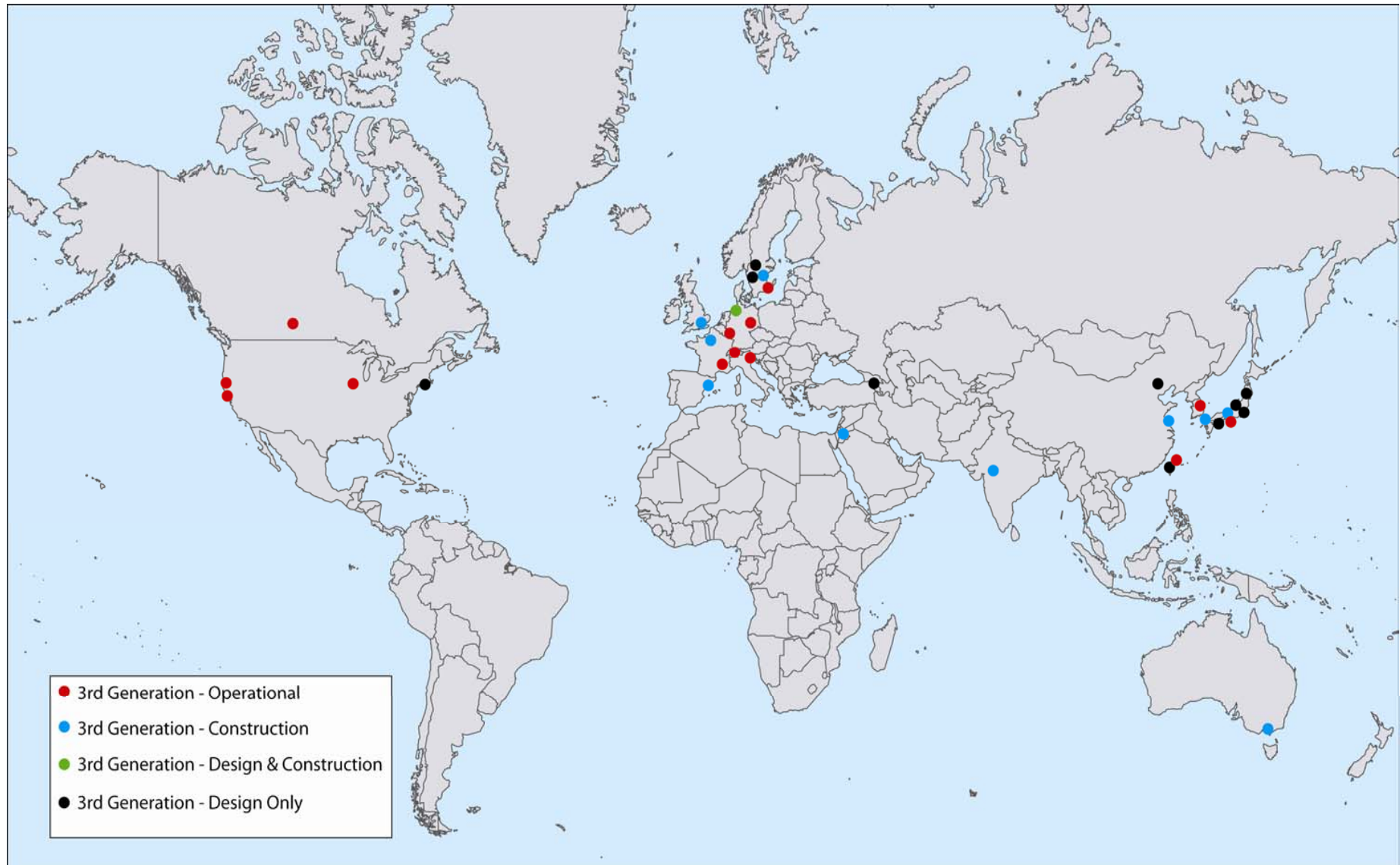
Map of Operating Synchrotrons (June 2005)



Courtesy of S. Dierker, NSLS/BNL

Synchrotrons circa 2015

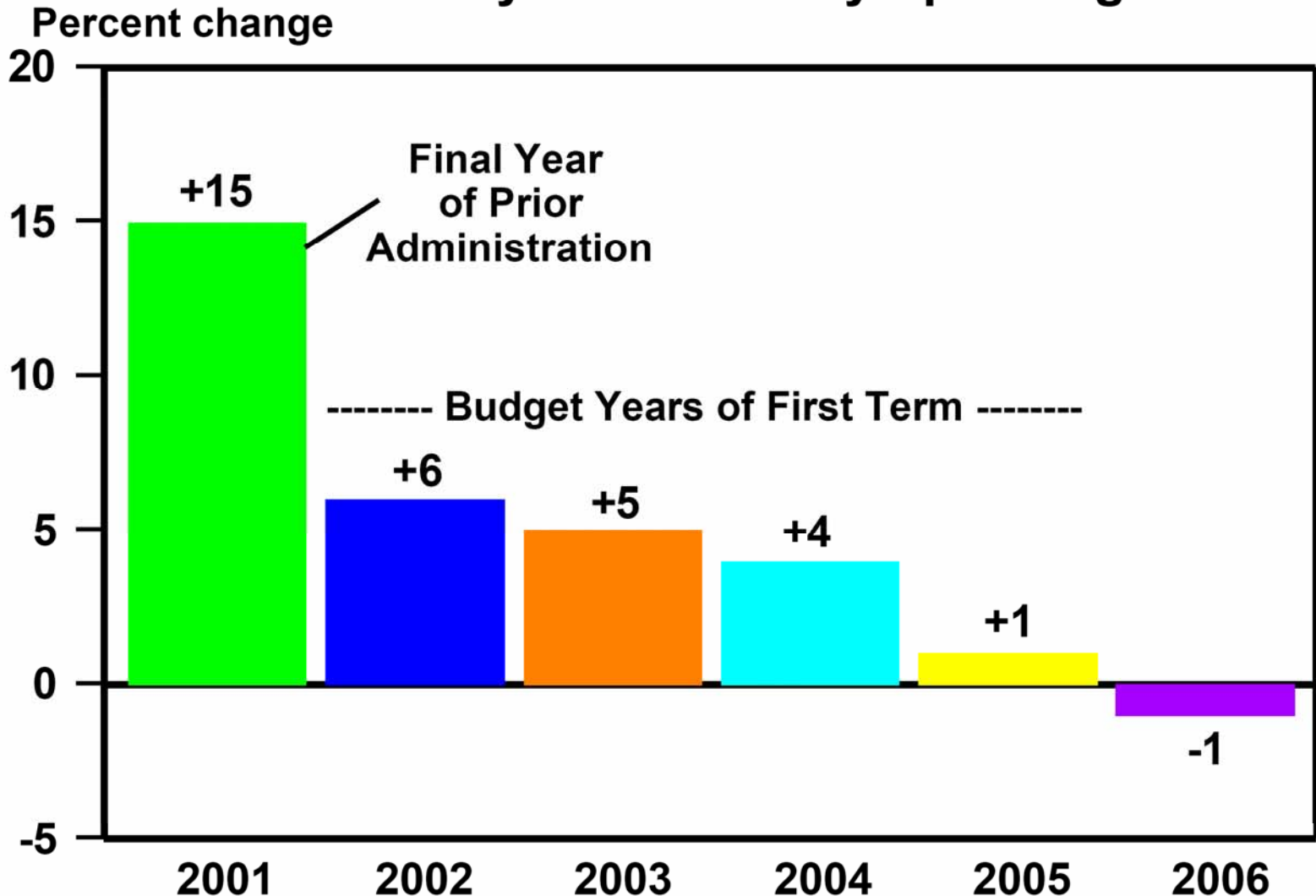
current 3rd generation, sources in construction, sources currently in design



Courtesy of S. Dierker, NSLS/BNL

Spending Restraint

Non-Security Discretionary Spending



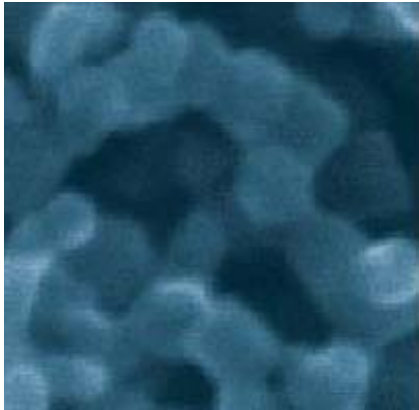
X-Ray and Neutron Scattering Facilities and Nanoscience: Making the Case

- Which of the outstanding problems in nanoscale synthesis, structure, dynamics, and properties can be addressed using X-ray and neutron techniques such as scattering, imaging and spectroscopy?
- How can these techniques help illuminate the important and urgent issues at the nanoscale?
- How might the current resource base in X-ray and neutron scattering techniques be augmented and used in solving outstanding problems in nanoscale science?
- What grand challenges of the NNI will need advanced characterization capabilities at the nanoscale within the next 5-10 years that may be addressed using x-ray or neutron scattering techniques?

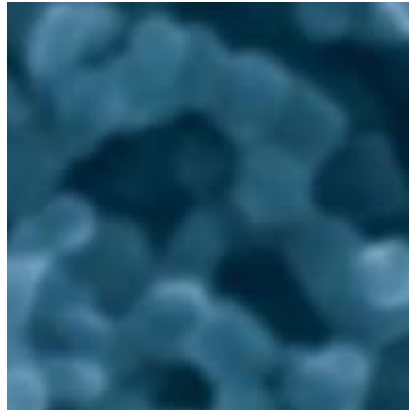
X-Ray and Neutron Scattering Facilities and Nanoscience: Making the Case

- What techniques will be most promising to meet the grand challenges? What adaptations will be needed?
- What performance goals will be needed? (e.g. 1 nm spatial resolution for imaging, etc)
- What instrumentation must be developed to meet these challenges? What are the bottle-necks in these developments?
- What are the near-term and long-term R&D and technology needs to develop the instruments and techniques? (automation, beam optics, detectors, etc. that will be required)
- What additional capabilities will be needed to maximize the impact of these facilities?
 - Fabrication, other characterization tools, remote access, robotics?

Example: What will 1 nm spatial resolution get you?



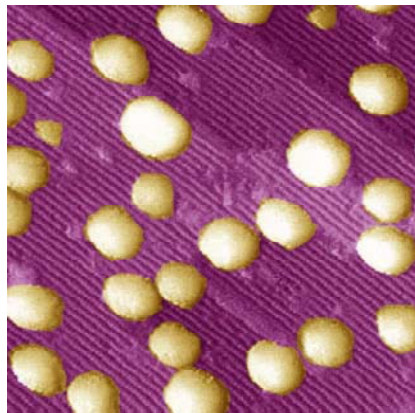
Scanning electron micrograph of titanium dioxide nanocrystal aggregates



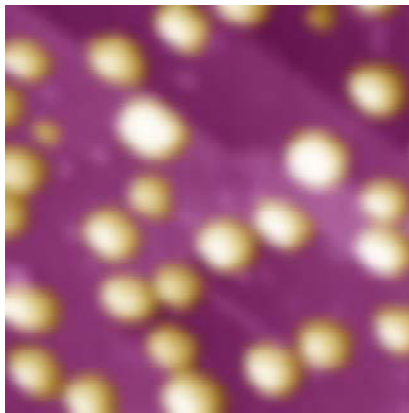
Simulated 1 nm Resolution



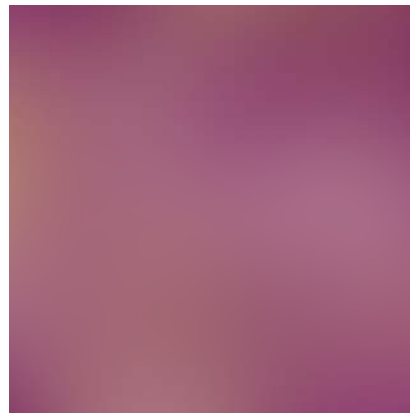
Simulated 10 nm Resolution



Scanning tunneling micrograph of gold clusters on titanium



Simulated 1 nm Resolution



Simulated 10 nm Resolution

